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ABSTRACT

This research project assessed: (1) the practicality of recording heart rate in 18-month-old infants as they watched events filmed on color, silent motion picture films; and (2) the validity and sensitivity of heart rate change as an index of differential attention arousal elicited by changes within and between complex visual events. The research also attempted to replicate the results of Golinkoff's experiments which probed for cognitive categories in infants having relevance for linguistic development. Twelve male and 12 female infants, 17-19 months of age, were randomly assigned to one of three transformation groups involving anomaly with a direction change, anomaly with a position change, or a nonanomalous transformation that involved a position and direction change. Heart rate and visual fixations were recorded as each subject was presented with the standard event, repeated six times, followed by one of the three transformation events, repeated six times. Findings indicated that heart rate can be measured in 18-month-olds watching filmed events and that heart rate seems to sensitively assess attentional changes. (SDH)

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Golinkoff (1973) attempted to probe for cognitive categories in infants which have relevance for linguistic development. She tried to assess whether minimally verbal infants function with the cognitive categories of "agent" and "recipient", which are relational categories defined by the linguists Chafe (1970) and Fillmore (1968) in terms of the role they play in a sentence. "Agent" is defined as the animate instigator of a transitive action and "recipient" is defined as the animate or inanimate object of the action. Golinkoff operationalized the question of whether infants could perceive the difference between agents and recipients by comparing infants' visual fixation times to three different experimental events presented on color, silent motion picture films. These events were constructed to be more or less discrepant from an additional standard event. One film included a violation of the restriction on the agentive class by having an inanimate object appear to be performing actions. Two groups of males, ages 14 to 18 months and 20 to 24 months, were presented with a series of repetitions of a standard event followed by a series of repetitions of one of the three types of experimental events. The standard might be described as "boy pushes table from left to the right", (B $\longrightarrow$ T). The three variations of the standard agent-recipient relationship that were used as experimental events included two in which

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the agent-recipient relation was reversed thereby presenting the anomalous situation of the table "pushing" the boy. One of these transformations, AP, involved the boy and table having switched their positions with the direction of action being identical to the standard event (T $\longrightarrow$ B). The other anomalous change, AD, involved the table "pushing" the boy with the direction of action reversed from the standard (B $\longleftarrow$ T). The third transformation, PD, was conceived as a control event since it altered superficial, perceptual features of position and direction, but did not change the agent-recipient relationship, in other words, the boy still pushed the table (T $\longrightarrow$ B).

Infants fixated longest on the transformation involving anomaly with a direction change (AD), second longest on the anomaly with a position change (AP), and finally, least fixation time was spent on the transformation which was not anomalous but involved a position and direction change (PD). The interpretation given to this finding was that since infants as young as fourteen months will recognize and show interest in an anomalous event, some conceptual representation of the linguistic semantic category involving action role may be available before the baby produces speech.

Visual fixation is a relatively gross measure for assessing attention to changes in complex events of the type described above. Heart rate deceleration has been considered a component of the

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attentional response and has been successfully used with babies in a number of studies (e.g., Lewis, Kagan, Campbell, and Kalafat, 1966). None of the studies, however, used complex visual events of the type used by Golinkoff. Golinkoff's stimulus material was therefore employed to learn whether her results could be replicated with heart rate, and thereby assessing (a) the practicality of recording heart rate in 18-month-old infants as they watched filmed events, and (b) the validity and sensitivity of heart rate change as an index of differential attention arousal elicited by changes within and between complex visual events.

METHOD

Materials and Design

Golinkoff's material as described above was used. Each subject was assigned to one of the three transformation conditions. In each condition S's were presented first with the standard event repeated six times followed by one of the transformation events; PD, AP, AD, repeated six times. Each event was six seconds long. There was a three second black blank between all events. The sequence of action during the standard and PD transformation events was as follows: Boy and table face each other with no movement. Boy takes two steps toward table with hands slightly lifted, palms down. He pushes table off screen. In the two anomalous transformations, AP and AD, the table moves first, the equivalent of two steps. As before, the boy

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raises his hands. The table contacts the boy's hands and "pushes" him off the screen.

Subjects and Procedure

The Ss were 12 boys and 12 girls. The mean CA was 18.1 mo., with a range of 17-19 mo. S's were randomly assigned to one of three transformation groups containing 4 males and 4 females. The mother was fully informed about the purpose and procedure before she brought the baby in. After an initial adaptation period, electrodes were placed on the subject's chest by E, two cm. below each nipple and a third ground electrode was placed at the midline two cm. above the nipple line (See e.g., Sameroff, Cashmore, and Dykes, 1973). The subject's mother seated him in a highchair two and a half feet from a rear projection screen. The mother sat to the right and slightly to the rear of the infant. E, who sat to the left and slightly to the rear of the subject, offered the baby a large, hard pretzel stick, and then the film was started. An observer, hidden from view behind and to the left of the viewing screen, recorded the S's visual fixation during the film. Previous reliability investigations showed correlations of .99 between two observers. A machine-operator remained out of sight during the entire procedure.

Equipment

A Kodak Electrographic Super-8 projector projected a 13" x 9" image of the stimulus film onto a rear-view Polacote screen. A photocell activated a signal input to one channel of the oscillograph

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whenever the stimulus event was on. The observer depressed a switch which provided a signal input to a second oscillograph channel when S was looking at the screen. A third oscillograph channel was actuated with the three EKG electrodes. The oscillograph was a Grass Model 7. The electrodes were fed into a Grass Model 7P4 combined amplifier and tachograph. The tachograph recorded instantaneous beat to beat change in rate of EKG and transferred the lapsed time between pulses to beats per minute with a linear writeout. The oscillograph was warmed-up and calibrated as per Grass manual instructions for each subject. Chart speed was maintained at 5 mm/sec.

RESULTS

Procedure with Data

All events were divided into six one-second intervals starting at onset. The average heart rate for each second during which S was visually fixated was calculated from the oscillograph readout. In addition, the average heart rate for the one second prior to and the one second after each event was found. The average heart rate for the one second prior to the event was used as a base rate for the event which followed. The average rate for each second during the event was subtracted from the base rate for that event. These differences constituted the data for all analyses. Results were based on data from the first two and last two presentations of the standard, and the first two presentations of each transformation event.

Since S did not always fixate an entire event there were missing data. Five percent of the total number of observations employed in the analyses below were missing. The mean of the smallest subgroup of which the missing observation was a member was substituted.

Analyses of Variance

All ANOVA's were three-way with one additional nested factor: transformation (PD, AP, AD) X second (six composing the event plus the one after the event) X subjects (24, 4 nested in each sex by transformation subgroup. Figure 1 graphically presents the reliable effects.

Insert Figure 1

All curves in Figure 1 represent the change in heart rate from a base (as described above) for each second averaged over two events and the appropriate subjects. Standard #1 (S_1) used the first two events of the standard block on which S fixated for at least seconds two through five during the event. Standard #2 (S_2) used the last two standard events fitting the same criterion as above. The curves labelled PD, AP, and AD represent a similar average for the first two trials of each transformation condition.

The standard curves, both S_1 and S_2, produced by the three different groups of subjects representing the three transformation conditions did not reliably differ from each other; therefore, a single

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curve, averaged over all S's is presented for each of the two standards. The differences between the means of the transformations conditions were reliably different ($p < .05$) indicating that heart rate is sensitive to between event change. The means of the transformation conditions were in the same order as Golinkoff's results using visual fixation supporting the validity of heart rate. The main effect of seconds is reliable in all instances ($p < .001$) indicating that heart rate is sensitive to within event change. The interaction between S_1 and S_2 and seconds is reliable ($p < .01$) indicating that habituation represented by a decreasing deceleration occurs during the presentation of repeated events. In addition from Figure 1, while it seems that there is dishabituation for both AP and AD, heart rate deceleration is reduced in the PD condition. Not represented in Figure 1 were reliable sex differences with males showing more habituation from S_1 to S_2 than girls. This corresponds to findings by others (eg., Cohen, 1972) regarding infant sex differences in habituation.

CONCLUSION

Heart rate can be measured in 18-month-olds watching filmed events. Heart rate seems to sensitively assess attentional changes in 18-month-old infants as a function of viewing changes within and between complex events.

Golinkoff (1973) has shown that filmed events may be used to contrast action parameters and operationalize the cognitive counterparts

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of linguistic categories. Results of the present study support her finding that infants can distinguish between filmed events along semantically defined action parameters. By monitoring differential attention arousal within events and across ages, the use of heart rate with visual fixation may permit psychologists to study the cognitive precursors of semantic categories with more precision than with visual fixation alone.

PD
AP
AD
HR DIFFERENCE IN BPM
2
0
.2
.4
.6
.8
1 2 3 4 5 6 7
1 2 3 4 5 6 7
SECONDS

Figure 1

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